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PROBLEMS.

44. Proposed by F. P. MATZ, M. Sc., Ph. D., Professor of Mathematics and Astronomy in New Windsor College, New Windsor, Maryland.

A, B, and C together bought a ship. A paid for the a/bth, $=\frac{2}{9}$th, part of the ship. B paid for the m/nth, $=\frac{3}{8}$th, part of the ship. C paid $\$M$, $=\$2000$. How many dollars did A, and B, pay?

45. Proposed by F. P. MATZ, M. Sc., Ph. D., Professor of Mathematics and Astronomy in New Windsor College, New Windsor, Maryland.

In running a mile, A can give B $a=20$ yards; B can give C $b=88$ yards. How many yards can A give C?

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ALGEBRA.

Conducted by J. M. COLAW, Monterey, Va. All contributions to this department should be sent to him.

SOLUTIONS OF PROBLEMS.

34. Proposed by ROBERT J. ALEY, A. M., Professor of Mathematics, Indiana University, Bloomington, Indiana.

$$\Sigma_1^n\frac{(n+2)^2}{n(n+4)}=\text{what?}$$

Solution by J. F. W. SCHEFFER, A. M., Hagerstown, Maryland.

$$\Sigma_1^n\frac{(n+2)^2}{n(n+4)}=\Sigma_1^n\left[1+\frac{4}{n(n+4)}\right]=\Sigma_1^n(1)+4\Sigma_1^n\frac{1}{n(n+4)}=n+4\Sigma_1^n\frac{1}{n(n+4)}.$$

$$\text{But } 4\,\Sigma_1^n\frac{1}{n(n+4)}=\left(\frac{1}{1}-\frac{1}{5}\right)+\left(\frac{1}{2}-\frac{1}{6}\right)+\left(\frac{1}{3}-\frac{1}{7}\right)+\left(\frac{1}{4}-\frac{1}{8}\right)+\dots$$

$$+\left(\frac{1}{n-4}-\frac{1}{n}\right)+\left(\frac{1}{n-3}-\frac{1}{n+1}\right)+\left(\frac{1}{n-2}-\frac{1}{n+2}\right)$$

$$+\left(\frac{1}{n-1}-\frac{1}{n+3}\right)+\left(\frac{1}{n}-\frac{1}{n+4}\right)=1+\frac{1}{2}+\frac{1}{3}+\frac{1}{4}-\frac{1}{n+1}-\frac{1}{n+2}$$

$$-\frac{1}{n+3}-\frac{1}{n+4}=\left(1-\frac{1}{n+1}\right)+\left(\frac{1}{2}-\frac{1}{n+2}\right)+\left(\frac{1}{3}-\frac{1}{n+3}\right)+\left(\frac{1}{4}-\frac{1}{n+4}\right)$$

$$=\frac{n}{n+1}+\frac{n}{2(n+2)}+\frac{n}{3(n+3)}+\frac{n}{4(n+4)}.$$

$$\therefore\quad \Sigma_1^n \frac{(n+2)^2}{n(n+4)}=n\left[1+\frac{1}{n+1}+\frac{1}{2(n+2)}+\frac{1}{3(n+3)}+\frac{1}{4(n+4)}\right].$$

Also solved by *Professor G. B. M. Zerr.*

35. Proposed by COOPER D. SCHMITT, A. M., Professor of Mathematics, University of Tennessee, Knoxville, Tennessee.

Prove that the product of two numbers, each the sum of four (4) squares may be expressed as the sum of four squares in 48 different ways and unite some or all of the 48 ways.

Solution by Professor G. B. M. ZERR, A. M., Principal of High School, Staunton, Virginia.

Let $(a^2+b^2+c^2+d^2)(e^2+f^2+g^2+h^2)=A=$ the product of the two numbers. From Euler's Theorem we get

$$\begin{aligned}
A&=(ae+bf-cg-dh)^2+(af-be-ch+dg)^2\\
&\qquad+(-ag+bh-ce+df)^2+(ah+bg+cf+de)^2,\\
&=(-ae+bf-cg+dh)^2+(af+be+ch+dg)^2\\
&\qquad+(ag+bh-ce-df)^2+(ah-bg-cf+de)^2,\\
&=(ae-bf-cg+dh)^2+(af+be-ch-dg)^2\\
&\qquad+(ag+bh+ce+df)^2+(-ah+bg-cf+de)^2,\\
&=(ae+bf+cg+dh)^2+(-af+be-ch+dg)^2\\
&\qquad+(ag-bh-ce+df)^2+(ah+bg-cf-de)^2,\\
&=(ae-bf+cg+dh)^2+(af+be-ch+dg)^2\\
&\qquad+(ag-bh-ce-df)^2+(ah+bg+cf-de)^2,\\
&=(ae-bf-cg-dh)^2+(af+be+ch-dg)^2\\
&\qquad+(ag-bh+ce+df)^2+(ah+bg-cf+de)^2,\\
&=(ae+bf-cg+dh)^2+(af-be+ch+dg)^2\\
&\qquad+(ag+bh+ce-df)^2+(ah-bg-cf-de)^2,\\
&=(ae+bf+cg-dh)^2+(af-be-ch-dg)^2\\
&\qquad+(ag+bh-ce+df)^2+(ah-bg+cf+de)^2.
\end{aligned}$$

The sum of four squares in eight different ways by combination of signs.

$$\begin{aligned}
A&=(ae+bf)-cg-dh)^2+(af-be-ch+dg)^2\\
&\qquad+(-ag+bh-ce+df)^2+(ah+bg+cf+de)^2,\\
&=(ag+bf-ch-de)^2+(af-bg-ce+dh)^2\\
&\qquad+(-ah+be-cg+df)^2+(ae+bh+cf+dg)^2,
\end{aligned}$$